HADRONIC JOURNAL 46, 41 - 83 (2023)
DOI 10.29083/HJ.46.01.2023/SC41

THE WORLD MEDIUM AS THE PRIMORDIAL MATTER. GENESIS OF MASS-TIME-CHARGE QUANTITIES

Vladimir Aphonin
Mordovian State University
430005, Saransk, Russia
aphoninvv@mail.ru

Received February 23, 2023
Revised March 6, 2023

Abstract

The work is a development of the concept outlined in monograph "Mathematical foundations of ether mechanics". The hypothesis is introduced that at the deepest level of matter there are no mass-time-charge properties; these properties are synthesized with the complication of forms of motion. Mechanical models for the synthesis of these properties and a mathematical description of the models are presented. On the basis of these models, the fundamentals of physics, alternative to the physics of the XX century, are presented: an alternative mathematical explanation of the Michelson experiment and an analytical derivation of the de Broglie formula are given. Mechanical models of electromagnetism are presented. In conclusion, it is concluded that the physics of the XX century are palliative methods of description, but not the actual structure of the Universe

Keywords: World medium; Ether; Mass; Time; Charge; Electron; De Broglie formula: Electromagnetism

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1 Introduction

The totality of theoretical arguments indicates that the world medium (let's call it ether) must exist. However, the experiment does not confirm this philosophical and qualitative reasoning. The ether has not been detected by direct experiment, although there are many indirect experiments in favor of its existence.

The problem of ether is the greatest problem of physical science. If we believe that the greatest scientific problem can be solved in an ordinary way by finding some equations, without cardinal changes in the approach to considering the movement of this medium, then this means underestimating the greatness of the problem. To describe the ether, it is necessary to move to another level of thinking. It is necessary to define the most general approaches to the study of ether, that is, to create a PHILOSOPHY of ETHER. Being dismissive of philosophy, one can wander for hundreds of years unsuccessfully in attempts to construct the theory of ether within the framework of secondary, non-fundamental concepts.

To create the philosophy of the ether, consider the hierarchy of forms of motion of matter. According to the doctrine of the forms of motion of matter, there are forms of motion that differ in degree of complexity. The lowest form is the mechanical form of motion (described in terms of Newton's physics), the highest forms are biological, social and other forms. The higher forms are formed from the lower ones through synthesis – a jump-like transition from a lower form to a higher one. With such a leap, new properties, attributes of matter arise. To describe a higher form requires more terms and concepts than to describe a lower form. Following this logic, it can be assumed that the "primordial matter" should not have any properties at all: all properties arise in the process of complicating the forms of movement. One of the expressions of this thesis is Kelvin's maxim: "...it is scarcely possible to help anticipating in idea the arrival at a complete theory of matter, in which all its properties will be seen to be attributes of motion" [1]. Within the framework of this logic, we come to the conclusion that the description of the microcosm should be simpler than the description of the macrocosm. Such a thesis is in contradiction with modern physics, in which, for example, it is stated that "the quantum mechanical description is more complicated than the classical one". From the standpoint of this concept, experiments that are not understood by the science of the XX century can be explained in the framework of incomparably simpler, and at the same time model mechanical representations.

Let us introduce the hypothesis that the lowest form of motion of matter, the "primordial matter" is ether. And also assume that the resting ether has no properties at all inherent in the objects studied by Newton's physics. The ether has no "mass density", there is no fundamental quantity "time", there is no property "electric charge"; all these properties must be explained by the mechanical motion of the

ether. Ether is not an ordinary macroscopic liquid or gas, which is described on the basis of generally accepted theories of continuous media. Instead of complicating the properties of the ether, which was carried out when trying to describe the ether, there is a simplification, a transition to a lower form of motion of matter. The motion of the ether can be described using only three mechanical quantities: energy E, momentum $\bar{Q}$, and extension l.

In the monograph [2] these philosophical arguments are put on a concrete mathematical basis. The interpretation of the experimental facts is presented from the standpoint of the kinetic theory of matter, according to which all conceivable space is filled with some homogeneous medium (medium, ether, physical vacuum) and vortices can exist in this medium. The verbal formula of the kinetic theory of matter is written as follows:

SUBSTANCE (AND FIELD) = MATTER (ETHER) + MOTION (I)

According to (I), a medium at rest has no properties (including mass). If mechanical motion is introduced into the medium, then a substance or field appears. All properties of matter are attributes of mechanical motion.

According to the concept of Cartesianism, all natural phenomena must have a mechanical model. This means that all physical quantities must be expressed as functions of only mechanical quantities. The mechanical quantities describing motion are energy E, momentum $\bar{Q}$, and extension l. Thus, instead of the basic system l,m,t of quantities of Newton's physics, a system $l,E,\mathbf{Q}$ of quantities is proposed.

2 The Ether model

Let there be a continuous superfluid medium consisting of infinitesimally small particles-points, which, like a photon, have no rest mass. Unlike photons, ether points can be at rest. If such a medium is at rest, then the energy density and, accordingly, the mass density are zero. If the points of the ether are moving, then they have energy and mass. The dependence of the energy E of the unit volume of the medium on the magnitude of the pulse Q is the same as for a photon:

$$E = cQ \tag{1}$$

In the usual interpretation, this formula means that the photon energy E is equal to the product of the photon velocity c by the magnitude of the pulse Q. In the proposed basic system of quantities, there is no concept of time, so there is no concept of the speed of light. The value c is not the speed of light, but the proportionality coefficient in a linear relationship (1). The value c is measured not in

meters per second, but in units of fundamental quantities $[E/Q]$. The equation of motion of the ether [2-3]

$$-\bar{\nabla}p = \bar{\nabla}a^2 \tag{2}$$

The acting vector in equation (2) is a vector **a**. The modulus of the vector **a** is equal to the geometric mean of the modules of the vectors **c** and **q**

$$q/a = a/c \text{ , or } a^2 = cq = \varepsilon, \tag{3}$$

where **q** is the momentum density, ε is the energy density. For comparison, we write down the Euler equation of an ideal medium (let us call it "Eulerian fluid") in the absence of external volumetric forces [5]:

$$-\frac{1}{\rho_E}\nabla p = \frac{d\mathbf{v}}{dt} = \frac{\partial \mathbf{v}}{\partial t} + (\mathbf{v}\nabla)\mathbf{v} \text{ (Euler)} \tag{4}$$

Comparison of equations (2) and (4) shows, firstly, that the equation of the world medium of this model is simpler than the equation of macroscopic media. Secondly, there is no partial derivative in equation (2) with respect to time. However, the equation is also valid for non–stationary modes, since the arguments of motion - energy and momentum are implicitly present in the right side of the equation.

3 The genesis of the quantities "mass" and "time"

Consider the genesis of mass. The vectors **c** and **q** coincide in the direction, so we can introduce a scalar function $\rho(\varepsilon)$ that establishes the proportionality between the vectors **c** and **q**:

$$\mathbf{q} = \rho(\varepsilon)\cdot\mathbf{c} \tag{5}$$

The ratio (3) will be written as follows:

$$\varepsilon = \mathbf{cq} = cq = a^2 = \rho c^2 \tag{6}$$

The following relations follow from relations (3) and (6):

$$\mathbf{c} = \mathbf{a}/\sqrt{\rho}\,; \tag{7}$$

$$\mathbf{q} = \mathbf{a}\cdot\sqrt{\rho}\,. \tag{8}$$

The value $\rho(\varepsilon)$ in (5) and (6) can be considered as a variable mass density of a moving medium. If the medium is at rest, then the energy density ε and mass density $\rho(\varepsilon)$ are zero. If energy is introduced into the medium, then mass density also arises. Passing in (6) from differential quantities to integral ones, we obtain Einstein's formula

$$E = mc^2 \tag{9}$$

Thus, we obtain the value "mass" not as an argument of motion, but as a function of mechanical quantities $l, E, \mathbf{Q}$. The dimension of this function is: $[m] = [Q^2 / E]$.

The genesis of time is the most difficult part of the theory to understand. According to the proposed concept, there is no fundamental value of "time". It is antiphysical to believe that there is some kind of "time" that "flows" even when there are no changes in space. Changes in quantities in space do not occur due to the presence of the fundamental quantity "time", but due to the transfer of portions, quanta of field change. Thus, these changes must be described not as function of mystical quantity "time", but as function of real mechanical quantities $l, E, \mathbf{Q}$. That is, the process of "time flow" is a mechanical process and can be mathematically described using mechanical quantities. The partial derivative in time $\partial / \partial t$ disappears from the equations of motion.

According to Newton's representation, the total derivative d / dt of some quantity in time is equal to the sum of the partial derivative $\partial / \partial t$ in time and the convective derivative $(\mathbf{v}\nabla)$

$$d / dt = \partial / \partial t + (\mathbf{v}\overline{\nabla})$$

The convective derivative is a real value. But the partial derivative is an expression of Newton's mystical idea of time as a global quantity that flows independently of the state of motion. In the theory presented, the process of the "flow of time" is material and represents the convection of quantities characterizing the field. If there is an object that creates a field at a point A, then when the parameters of the object change, these changes come to the point A with some delay Δt

$$\Delta t = 2l / c \qquad (10)$$

The more fundamental quantity in this definition is the quantity c. The time interval Δt is a secondary value. The "time" function can be entered as the sum of these elementary delay values

$$t = \sum_{i=1}^{N} \Delta t_i \ , \qquad (11)$$

where N is the number of changes emission acts. The synthetic quantity t in (11) is a function of "time", measured in units of primary quantities; $[t] = [l \cdot Q / E]$. Formula (11) shows that time "flows" only when changes occur. Therefore, the "time" function is an integral, cumulative function of changes.

Since there is no value of "time", the concept of the velocity V of a body as a derivative of the distance in time also does not exist. The concept of translational velocity $\mathbf{V}$ of a body can be introduced, similar to the Hamiltonian formulation of dynamics as a derivative of the motion's energy T in momentum Q:

$$V = \partial T / \partial Q \tag{12}$$

3 The Michelson's Experiment

On the basis of such a model of the ether, there is a multiple simplification of physical representations. Consider, for example, the explanation of Michelson's negative result. The presented theory translates the solution of this problem from the category of esoteric problems of four-dimensional pseudo-Euclidean space-time into the category of problems for high school students. It is only necessary to move on to another system of concepts.

The principle of the constancy of the speed of light, introduced by Einstein, leads in SRT to monstrous distortions of physical representations. According to G. Minkovsky, space as an independent category disappears, and a new category arises – a four-dimensional pseudo-Euclidean space-time. In this concept, the explanation of the constancy of the "speed of light" does not require violence to physical representations. The speed of a quantum of light relative to a moving inertial reference frame (IRF) in any IRF is always equal to c, since the value c is the proportionality coefficient in linear dependence (1). Consequently, deformations of solid rods do not occur and the formulas of SRT kinematics are erroneous.

However, a difficulty arises. There are formulas for the dynamics of SRT

$$E_0 = m_0 c^2 \tag{13}$$

$$E^2 - c^2 Q^2 = m_0^2 c^4 \tag{14}$$

Where E is the total energy of a moving particle; $\mathbf{Q}$ is the momentum of a moving particle; c is the speed of light; m_0 is rest mass of the particle; E_0 - rest energy. These formulas have been experimentally tested many times, so there is no doubt about their validity, In SRT these formulas are obtained using kinematics formulas. Thus, the position arises that the Lorentz formulas are incorrect, but the SRT dynamics formulas are correct, In order to overcome this contradiction, it is necessary to prove the dynamics formulas without the help of kinematics formulas. Formula (13) is a special case of the proven formula (9), so only the relation (14) requires proof.

3.1 Proof of SRT dynamics formulae without kinematics formulae

Let's write down the expression of the total momentum $\mathbf{Q}$ of the particle

$$\mathbf{Q} = m\mathbf{V} \tag{15}$$

Where m is the total mass of the particle; $\mathbf{V}$ is the velocity of the particle. The vectors $\mathbf{V}$ and $\mathbf{Q}$ coincide in the direction, so it is possible to work in scalar form:

$$Q = mV \tag{16}$$

According to (9), the value of the total energy E of the particle divided by c^2 should be used as the total mass

$$m = E / c^2 = m_0 + T / c^2$$

The velocity V, according to the definition (12), is a derivative of the kinetic energy T by momentum:

$$V = \frac{\partial T}{\partial Q} = \frac{\partial (T + E_0)}{\partial Q} = \frac{\partial E}{\partial Q}, \tag{17}$$

Formula (16) takes the form:

$$Q = \frac{E}{c^2} V = \frac{E}{c^2} \frac{\partial E}{\partial Q} \tag{18}$$

The relation (18) is a differential equation with separable variables E and Q:

$$\frac{1}{c^2} E \cdot dE = Q \cdot dQ \tag{19}$$

We integrate both parts of the equation

$$\frac{1}{c^2} \int E \cdot dE = \int Q \cdot dQ$$

General solution of the equation

$$\frac{1}{c^2} E^2 = Q^2 + C, \tag{20}$$

where C is an unknown constant. We determine the constant C from the initial conditions. If $Q = 0$, then $E = E_0 = m_0 c^2$. Hence $C = E_0^2 / c^2$. Substitute in (20)

$$\frac{1}{c^2} E^2 = Q^2 + \frac{E_0^2}{c^2},$$

or

$$E^2 = c^2 Q^2 + E_0^2 = \left| E_0^2 = m_0^2 c^4 \right| = c^2 Q^2 + m_0^2 c^4$$

$$E^2 = c^2 Q^2 + m_0^2 c^4$$

This is the formula (14), but it was obtained without the use of SRT kinematics. Thus, based on this model of the world medium, experimentally confirmed SRT formulas for dynamic quantities – energy and momentum – have been obtained. Lorentz formulas lose their theoretical basis (they did not have an experimental basis) and "go into oblivion."

The above proof changes the priorities of physics. The formulas of SRT dynamics are correct, but the space is three-dimensional and Euclidean, which greatly simplifies the theoretical consideration of physical problems. In addition, the ether is returning to science, the existence of which has been a "religion" for most

scientists for centuries. However, physics of the first quarter of the XX century, having abandoned the ether, also abandoned mechanical, visual models of phenomena. As a result, a complex of sciences called "quantum physics" appeared. The presented concept shows that a rational explanation of experiments for which quantum mechanics has not found model explanations is possible precisely from the standpoint of the existence of the ether, that is, the world medium of the given model,

4 Circulation of surface forces

In the XIX century, when the concept of ether was the dominant doctrine of theoretical physics, properties of the intermediate medium were experimentally discovered, for which no theoretical explanations were found. The main of these experimentally discovered properties are the following two groups of experiments:

Problem 1) Transversity of electromagnetic waves;

Problem 2) the impossibility of detecting a world medium (ether) by a direct experiment, for example, such as the Michelson experiment.

The inability of theoretical physics to explain these experiments led to the fact that by the end of the XIX century the models of the intermediate medium became so cumbersome and artificial that no one believed in such esoteric models. Therefore, at the beginning of the XX century, with the creation of the SRT, there was a rejection of the concept of ether. The stated concept asserts that the reason for the impossibility of constructing a satisfactory model of the medium is that physics tried to create a model of the ether within the framework of Newton's physics, based on the theory of macroscopic continuous media. In [2-4], two errors of the theory of the ideal medium were revealed, on the basis of which the physics of the XIX century tried to construct a model of the ether. Solutions to these problems are presented:

Solution of problem 1): existence of circulation of surface forces along the contour of the vortex ring.

Solution to problem 2): erroneous idea of the value of "time": "time" is not a fundamental quantity, but a function of more fundamental quantities.

The solution of the second problem was described in section 3. Another problem of the ether's theory of the XIX century (historically arose earlier) is the problem of the transversity of light waves. If we consider light to be waves in the ether, then experiments on the polarization of light prove the transversity of these waves. However, this conclusion contradicts the ideas of science about the ideal medium. There is a Lagrange theorem, according to which the propagation of vortex motions through an ideal medium is impossible. The transversity of light waves means that a rotor or circulation of surface forces (or other related quantities: speed, acceleration)

must be present in the equation of the medium. Great forces of science of the XIX century were directed to solve this paradox, but the problem was never solved.

This problem is solved by the Author; the solution is set out below. The movements of the ether are potential, there is no circulation of velocity or acceleration along a closed circuit; therefore, the search for science of the XIX century in this direction is erroneous. The essence of the solution is that there is a circulation of surface forces along the contour of the vortex ring. At the same time, circulation exists only in the integral form, the ultimate transition to the differential form is impossible. Light and other electromagnetic vibrations are waves in the world medium; however, the transversity of these waves is a consequence of the existence not of a rotor of surface forces, but of the existence of a circulation of surface forces along a finite contour.

In the ideal medium described by equation (2), various types of flows are possible. Since movement is potential, there is potential Φ of a vector $\mathbf{a}_0$.

$$\nabla\Phi = \mathbf{a}_0 \tag{21}$$

The meaning of the subscript 0 for the vector $\mathbf{a}_0$ will be explained further. All possible flows must be a combination of the simplest flows of an ideal medium. The simplest flows are the drain and the source, but these flows are physically impossible, since they assume the appearance of matter "out of nothing" at the source points and the disappearance of matter at the drain points. The simplest, physically possible flow is a vortex ring in the ether.

To prove the existence of the circulation of surface forces, we first consider the motion of an ideal liquid described by the Euler equation (4). According to the dynamics of ideal media, the vortex ring field is described by Ampere's theorem [5, p. 290]:

$$\Pi_A = -\frac{\Gamma}{4\pi}\int_\Sigma \frac{\partial}{\partial n}\left(\frac{1}{r}\right)d\sigma, \quad \text{(Ampere)} \tag{22}$$

The velocity $\mathbf{v}$ of the liquid particles is equal to the potential Π_A gradient:

$$\mathbf{v} = -\frac{\Gamma}{4\pi}\nabla\int_\Sigma \frac{\partial}{\partial n}\left(\frac{1}{r}\right)d\sigma \tag{23}$$

According to (22), the Ampere potential Π_A created by the vortex ring is equivalent to the potential created by the continuous distribution of dipoles over the surface tightened by the contour of the vortex ring. This theorem was obtained by Ampere under the assumption that the motion of the liquid is strictly potential, that is, there is no rotor or circulation of surface forces. However, there is a circulation of surface forces along the contour of the vortex ring. This circulation exists in a

somewhat unusual form, not described in the world literature on continuum dynamics. The motions of a continuous liquid are potential if there is an isotropy of stresses. In an ideal liquid, the tangential stresses are zero, the stress tensor is spherical. So, by all visible signs, a rotor and, accordingly, the circulation of surface forces cannot exist in an ideal liquid.

However, when vortex filaments exist in an ideal liquid, there is a phenomenon of the so–called ***integral anisotropy*** (the term was introduced by me - A.V.). This phenomenon was first noted by Maxwell [6, p. 115], but he did not obtain the corresponding mathematical consequences from this phenomenon. It consists in the fact that normal stresses are isotropic, but the forces of normal stresses are different, that is, there is anisotropy of the forces of normal stresses. As a result, the circulation along any infinitesimal contour is zero, but the circulation along the contour of the vortex ring is not zero; at the same time, the ultimate transition to an infinitesimal contour is impossible. On the basis of this idea, the existence of the circulation of surface forces is proved, but not in the form in which physics of the XIX century tried to find circulation.

To prove this statement, consider the stationary motion of a vortex ring in an ideal liquid described by the Euler equation (4). In [2] it is shown that the translational velocity of the ring is equal to the sum of two components: 1) gradient velocity $\mathbf{V}_{GRAD}$ and 2) circulation velocity $\mathbf{V}_{CIRC}$:

$$\mathbf{V}_{SUM} = \mathbf{V}_{GRAD} + \mathbf{V}_{CIRC} \tag{24}$$

The component $\mathbf{V}_{GRAD}$ exists both in the vortex pair and in the vortex ring, but the component $\mathbf{V}_{CIRC}$ is caused by the curvature of the vortex line and exists in the vortex ring only. Let's analyze this component.

In stationary motion, there is an equality of forces acting on the ring element dl: the centripetal force $d\mathbf{F}_{CP}$ directed to the center of the ring and the centrifugal force $d\mathbf{F}_{CF}$ acting from the center. The origin of the force $d\mathbf{F}_{CP}$ is illustrated in Fig. 1. Two tensile forces $\mathbf{G}_1$ and $\mathbf{G}_2$ of equal magnitude and directed along the normal to the cross-section plane act on the ends of the element dl. The magnitude G of these forces can be calculated as follows [2, p. 146]:

$$G \approx \lim_{\sigma \to \infty} \int_{\sigma} (p_0 - p) \cdot d\sigma, \tag{25}$$

where σ is the cross-section of the vortex; p_0 is the pressure at infinity; p is pressure in the cross section of the vortex. Since the element dl is curved, and the forces $\mathbf{G}_1$ and $\mathbf{G}_2$ are directed at an angle to each other, then there is a resultant

$d\mathbf{F}_{CP}$ of these forces directed to the center of the ring. The magnitude of this centripetal force

$$dF_{CP} = G \cdot d\alpha \ , \tag{26}$$

where $d\alpha$ is the central angle of the element dl.

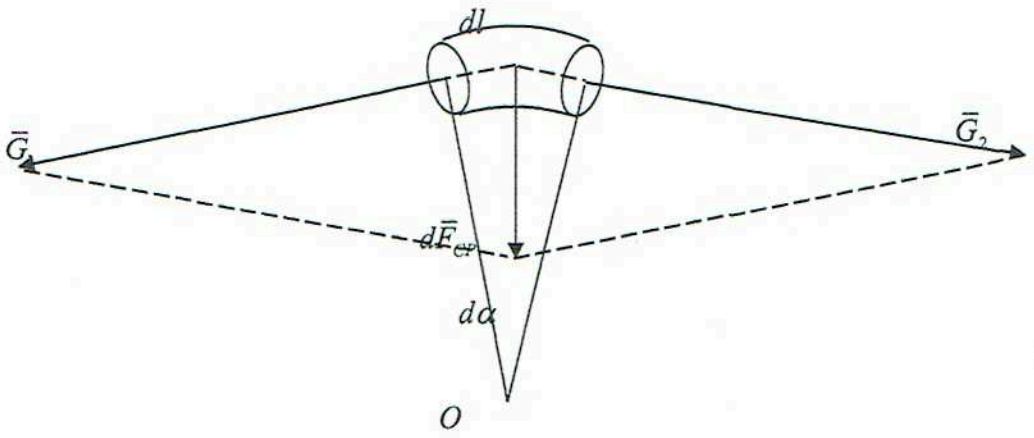

Fig. 1: Origin of the force $d\mathbf{F}_{CP}$ directed to the center of the ring. Two tensile forces $\mathbf{G}_1$ and $\mathbf{G}_2$ act on the ends of the element dl. Since the element is curved, there is a resultant of these forces directed to the center of the ring.

Since the element dl moves with translational velocity $\mathbf{V}_{CIRC}$, the Zhukovsky lifting force $d\mathbf{F}_{Zh} \equiv d\mathbf{F}_{CF}$ acts on it:

$$dF_{CF} = \rho_E \cdot \Gamma \cdot V_{CIRC} \cdot R_R \cdot d\alpha \tag{27}$$

where Γ is the circulation; ρ_E is density of the Eulerian fluid; R_R is the radius of the ring. Equating (26) and (27), we get

$$V_{CIRC} = \frac{G}{\rho_E \cdot \Gamma \cdot R_R} \tag{28}$$

Multiply the numerator and denominator of the right side (28) by the circumference of the ring $2\pi R_R$. The numerator in this case can be represented as the circulation of the surface force $\mathbf{G}$ along the contour L of the ring. The ratio takes the following form:

$$V_{CIRC} = \frac{1}{2\pi R_R^2 \rho_E \cdot \Gamma} \oint_L \mathbf{G} \cdot d\mathbf{l} \tag{29}$$

Thus, part $\mathbf{V}_{CIRC}$ of the translational velocity of the vortex ring can be expressed as a function of the circulation of the surface force. As is known, the potentiality of surface forces underlies the hydrodynamics of ideal media, therefore, the proof of the existence of the circulation of surface forces makes great changes in the theory. The author has investigated two main consequences of this proof:

1) The appearance of an addition to Ampere's theorem (23). This additive explains the genesis of the "electric charge of an electron" value, that is, the possibility of constructing mechanical models of electromagnetism. Since there is a circulation of surface forces, Ampere's theorem will be valid not in a stationary coordinate system, but in a system moving at speed $\mathbf{V}_{CIRC}$. To switch to a fixed coordinate system, it is necessary to add velocity $\mathbf{V}_{CIRC}$ to the velocity field (23). We obtain the corrected Ampere theorem [2, p. 127]:

$$\mathbf{v}_{SUM} = -\frac{\Gamma}{4\pi} \nabla \int_{\Sigma} \frac{\partial}{\partial n}\left(\frac{1}{r}\right) d\sigma + \mathbf{V}_{CIRC} \cdot \tag{30}$$

2) The possibility of explaining the transversity of electromagnetic disturbances propagating in the medium. The solution to this problem is presented in the following.

Thus, the presented theory solves the problems of physics of the XIX century, due to the impossibility of solving them (within the framework of Newton's ideas), the concept of ether was abandoned. However, in the XX century, after the creation of SRT, physics took a different path. Esoteric ideas of SRT have changed the mentality and worldview of physics: science has abandoned visual mechanical models. Emerging problems began to be solved only mathematically, without visual explanations. The following presentation shows how, on the basis of the proposed model of the world medium, the problems that led to the emergence of a complex of sciences under the general name "quantum physics" are explained.

5 Electron structure

The presented concept asserts that all phenomena, without exception, are based on a mechanical model. The theory asserts that such abstract concepts of modern physics as "electron charge e", "wave function ψ" can be understood visually, as properties of the mechanical movements of the ether. More specifically, these properties are the parameters of an electron as a vortex ring in the ether, that is, attributes of the motion of the world medium.

We introduce the hypothesis that an electron is a vortex ring in the ether. Thus, according to the presented concept, the electron is the simplest, physically possible solution of the Laplace equation for ether, with an addition due to the existence of circulation of surface forces. Based on such an electron structure, an explanation of the nature of the "electric charge" of an electron as a mechanical property of a vortex ring is given, mechanical models of electromagnetism are constructed, and rational explanations are given to experiments of the first quarter of the XX century. In the following presentation it is shown that:

1) "Charge" is an invariant of the motion of the vortex ring in the ether;

2) The de Broglie equation for the wave function is the equation of stationary motion of a vortex ring in the ether;

3) The electron spin is the intrinsic angular momentum of the vortex ring, which occurs when the ring is introduced into a constant magnetic field;

4) The wave properties of the electron can also be explained from these positions. A vortex ring is an elastic system. When this system is perturbed, vibrations occur in it, propagating along the perimeter of the ring.

It was shown above how simple both physically and mathematically, on the basis of the proposed concept the problems are solved, which are explained by modern science on the basis of SRT. Similarly, on the basis of the proposed concept, the picture of phenomena falling within the competence of quantum mechanics is multiply simplified. At the same time, the proposed theory constructs mechanical, visual models of phenomena. Experiments that do not have a model explanation in quantum mechanics find rational explanations from the standpoint of the stated theory of the ether.

In the science of the XIX century, there were many hypotheses about the nature of the electrical and magnetic properties of matter as mechanical properties of a vortex ring. Among these works, we can mention the works of Maxwell [6], Helmholtz [7], Kelvin [8] and etc. However, all these works assumed the solution of the problem within the framework of Newton's physics. In addition to this, the SRT, which appeared at the beginning of the XX century, extremely complicated the system of the Universe. Therefore, physics has found nothing better than the rejection of visual models and the formalization of mathematical description.

Let's consider how the presented concept explains the genesis of the electromagnetic properties of matter. The results obtained in section 4 for the ideal fluid of the Eulerian model can be transferred to a vortex ring in the ether. We consider only a thin vortex ring for which $V_{CIRC} \gg V_{GRAD}$. Ampere's theorem

$$\nabla\Phi_A = \mathbf{a}_A = -\frac{C}{4\pi}\nabla\int_{\Sigma}\frac{\partial}{\partial n}\left(\frac{1}{r}\right)d\sigma \qquad (31)$$

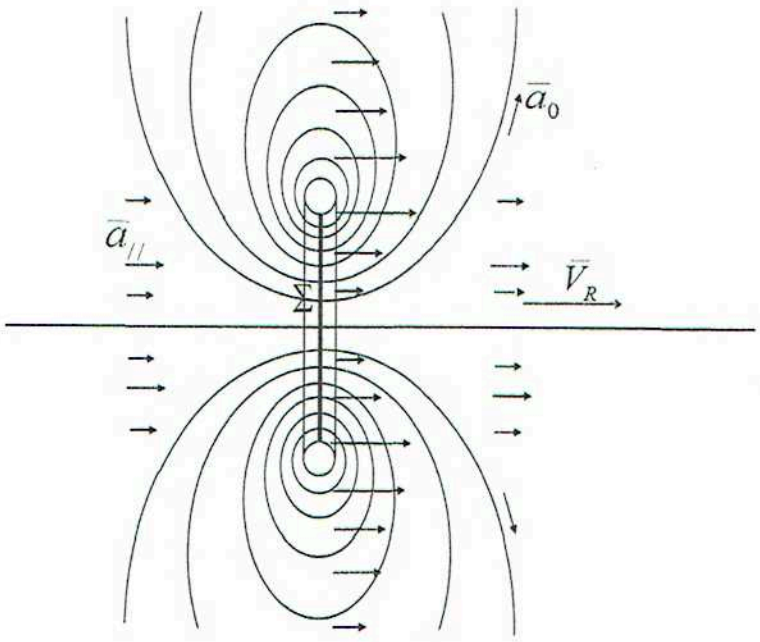

Fig. 2: Image of the field of a freely moving thin vortex ring in the ether. The field consists of two components: 1. Vector $\mathbf{a}_0$ lines - solutions of the Laplace equation for the dipole; 2. An additional vector $\mathbf{a}_{//}$ characterizing the kinetic energy density of the translational motion of the vortex ring.

Due to the existence of circulation of surface forces, an addition to Ampere's theorem arises. This additive can exist in two forms: 1) for the free movement of the ring; 2) for a ring stopped by external barrier. For the first mode, the corrected Ampere theorem [2, p. 161]:

$$\mathbf{a}_{R1} = -\frac{C}{4\pi}\nabla\int_{\Sigma}\frac{\partial}{\partial n}\left(\frac{1}{r}\right)d\sigma + \sqrt{\frac{\rho}{2}}\cdot\mathbf{V}_R, \qquad (32)$$

where Φ_A is the Ampere potential, C is the circulation of the vector $\mathbf{a}_0$ around the axis of the vortex; Σ is the surface resting on the contour of the vortex ring. The image of this field is shown in fig. 2. The field consists of two components: 1)

Vector $\mathbf{a}_0$ lines, this term expresses Ampere's theorem; 2) Lines of an additional vector $\mathbf{a}_{//} = \sqrt{\rho_0 / 2} \cdot \mathbf{V}_R$

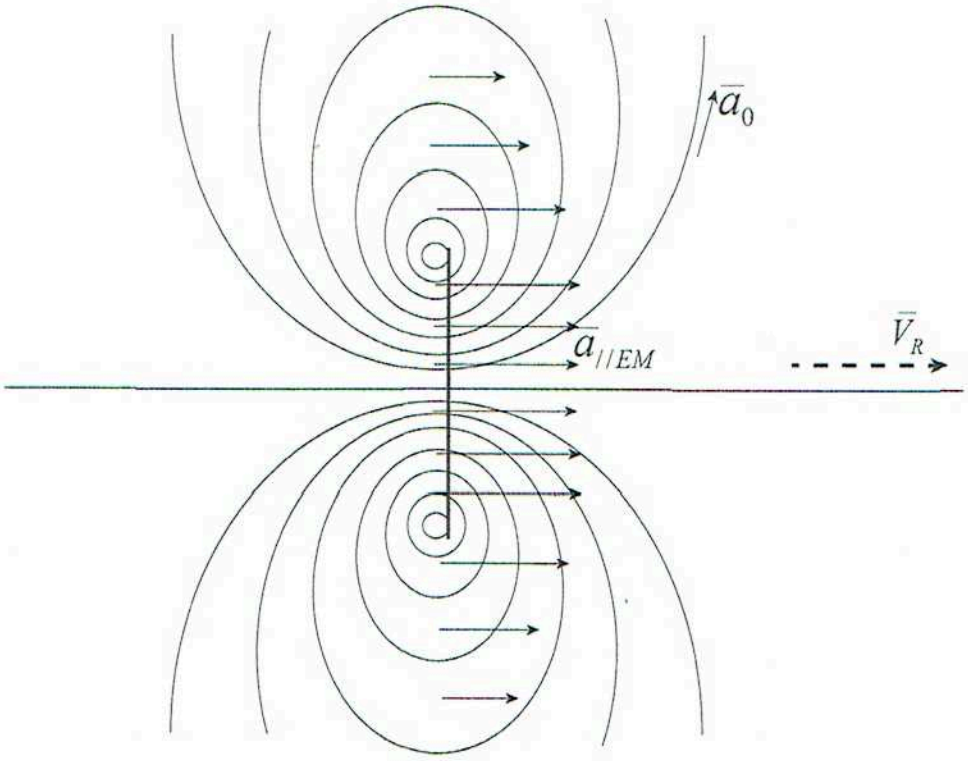

Fig. 3: Image of the field of a thin vortex ring stopped by external forces, that is, with an additive in the form (34). The barrier holding the ring from free translational motion is depicted by a bold line adjacent to the vortex core. Since the translational velocity is zero, the vector $\mathbf{V}_R$ is represented by a dotted line. The field consists of two components: 1. Vector $\mathbf{a}_0$ lines – solutions of the Laplace equation for the dipole; 2. Vector $\mathbf{a}_{//EM}$ – the vector of the satellite flow that occurs when the vortex ring is decelerated

If the ring is stopped by external forces, that is, an obstacle is imposed on the translational speed of the ring (Fig. 3), and then the following process occurs. Since when the ring stops, the translational energy $\varepsilon_{//} = \rho V_R^2 / 2$ of the thin ring cannot

disappear, it is transformed into the energy of the translational flow of ether. This flow moves in the direction of the stopped translational velocity of the ring at a speed of c.

Thus, when the ring stops, the ring becomes a "micro pump", driving a rectilinear vector $\mathbf{a}_{//EM}$ flow through itself. Let's call this stream an accompanying or satellite stream (sputny potok). The total field consists of the sum of the Ampere field (31) and the satellite flow field:

$$\mathbf{a}_{R2} = \mathbf{a}_A + \mathbf{a}_{//EM}, \tag{33}$$

Or in expanded form:

$$\mathbf{a}_{R2} = -\frac{C}{4\pi}\nabla\int_{\Sigma}\frac{\partial}{\partial n}\left(\frac{1}{r}\right)d\sigma + \mathbf{a}_{//EM}, \tag{34}$$

where $\mathbf{a}_{//EM}$ is the vector of the satellite stream.

Let's make the following statement. ***The total intensity of the vector*** $\mathbf{a}_{//EM}$ ***flow is a quantity that appears in modern physics under the name "electron charge*** e ***".***

$$e = \int_{\Sigma}\mathbf{a}_{//EM}\cdot\mathbf{n}\cdot d\sigma, \tag{35}$$

where Σ is an infinite cross-sectional plane. The dimension of the flow power coincides with the dimension of the charge in the natural system of units

$$[a\cdot\sigma] = M^{1/2}L^{3/2}T^{-1} = [e] \tag{36}$$

The meaning of this statement and the corresponding mechanical models will be presented in the following presentation. The subscript $_{EM}$, as will become clear from the following presentation, means that vector $\mathbf{a}_{//EM}$ describes the electromagnetic field. Depending on the different physical conditions in which the vortex ring can be placed, the satellite flow can create either a magnetic field or an electric field.

Consequently, the total field of an electron as a vortex ring in the ether consists of two components: 1) a vector $\mathbf{a}_0$, that is, the field of the ring itself, and 2) an additive $\mathbf{a}_{//}$ is a vector that can exist in two forms. It is shown in [2] that the additive $\mathbf{a}_{//}$ creates the properties of an electron, which are designated by the term "electromagnetism", and the vector $\mathbf{a}_0$ field creates a complex of phenomena that fall within the competence of quantum mechanics.

Thus, the original, innate properties of matter "mass", "time", "charge", which are considered fundamental quantities in modern physics, do not exist. These properties are synthesized when mechanical motion is introduced into the resting

ether. It is shown that these quantities can be expressed as functions of mechanical quantities $l, E, \mathbf{Q}$.

6 The physical meaning of the de Broglie equation

The basis of quantum mechanics is the de Broglie relation. At low energies, this formula has the form [9, p. 443]:

$$\frac{\lambda}{2\pi} = \frac{\hbar}{mV} \text{ (de Broglie, 1923)} \tag{37}$$

where λ is the de Broglie wavelength, $\hbar$ is the reduced Planck constant, m is the mass of the particle, V is the translational velocity of the particle. Formula (37) was obtained by de Broglie heuristic method, without analytical proofs. A visual mechanical model of this phenomenon does not exist in modern physics, so the number of interpretations of the (37) is permanently growing and is currently approaching twenty; this indicates that none of the interpretations is satisfactory. As a result, all quantum physics is just a set of mathematical methods of calculations, without understanding the physical essence of the phenomena described.

The theory being presented constructs simple, mechanical models of these phenomena. According to the proposed theory, ***the de Broglie equation is the equation of stationary motion of a vortex ring in the world medium.***

Let us first consider the logical prerequisites for the emergence of this idea, which subsequently led to a rigorous mathematical proof of the hypothesis. Another consequence follows from the elementary proof made in section 4. Consider formula (28) for the stationary motion of a vortex ring in an ideal fluid of the Eulerian model. Let's write this formula in the following form:

$$R_R = \frac{G}{\rho_E \cdot \Gamma \cdot V_{CIRC}}.$$

This formula is similar in structure to the de Broglie formula (37): in both formulas, the values either coincide or are close in meaning. The formula (28) was obtained by the Author in 1985, and there were expectations that if the equation of the world medium (ether) is obtained, then the equation of stationary motion of the vortex ring in the ether will take the form of the de Broglie equation (37). These expectations were justified: in 2005, on the basis of the already obtained ether equation (2), the equation of stationary motion of the vortex ring in the ether of the presented model was analytically obtained

$$R_R = \frac{K}{m \cdot V_R}, \tag{38}$$

where m is mass-energy of the ring; R_R is radius of the ring; V_R is translational velocity of the ring; K is angular momentum of the medium rotating around the circular axis of the vortex. If we assume that the magnitude of this moment is equal to the reduced Planck constant $\hbar$:

$$K \equiv \hbar, \tag{39}$$

and the circumference $2\pi R_R$ of the ring is the de Broglie wavelength λ:

$$2\pi R_R \equiv \lambda, \tag{40}$$

then we get the de Broglie formula. Formula (38) takes the following form:

$$R_R = \frac{\hbar}{m \cdot V_R}. \tag{41}$$

Relation (41) is the equation of stationary motion of a vortex ring in the world medium; we will call it the ***electron equation***. Based on (41), rational explanations of the formulas of quantum mechanics are given. The science of the first quarter of the XX century, having found this ratio heuristically, "blindly", could not understand its real mechanical meaning. Therefore, in order to interpret the experiments, a deformation of physical representations was carried out, remaining within the framework of Newton's ideas about the qualitative difference between matter and vacuum.

6.1 Proof of the relation (38)

Let us find out what form, in the case of a vortex ring in the world medium of the presented model, the relation (28) takes, which is valid for a thin ring in an Eulerian fluid. We consider the problem with simplifying assumptions, with the sole purpose of identifying the main pattern.

Consider the stationary motion of a thin vortex ring in the ether. The ring element dl is affected by the same forces that were considered in Section 4 when analyzing a vortex ring in an Eulerian fluid (Fig. 1). In stationary motion, there is an equality of the "centripetal" force $d\mathbf{F}_{CP}$ acting in the direction of the center of the ring and the "centrifugal" force $d\mathbf{F}_{CF}$ acting from the center.

Consider centripetal forces. Relation (24) shows that, in general, the translational velocity of the ring consists of two components: the gradient component $\mathbf{V}_{GRAD}$ and the component $\mathbf{V}_{CIRC}$ caused by the curvature of the vortex thread. According to some estimates, which we do not give here, for a thin vortex ring in the ether, the force due to the curvature of the vortex thread exceeds the gradient component of the force by several orders of magnitude. Therefore, the component $\mathbf{V}_{GRAD}$ is small

compared to $\mathbf{V}_{CIRC}$. Therefore, we believe that the entire translational velocity of the ring is due to the circulation of surface forces.

We consider the problem in the coordinate system associated with the vortex ring (Fig. 4). We introduce a Cartesian coordinate system xOy: the direction of the axis x coincides with the direction of the translational velocity vector $\mathbf{V}_R$ of the ring, the axis y lies in the plane of the ring. We also introduce a polar system r, φ where the angle φ is measured from the axis x.

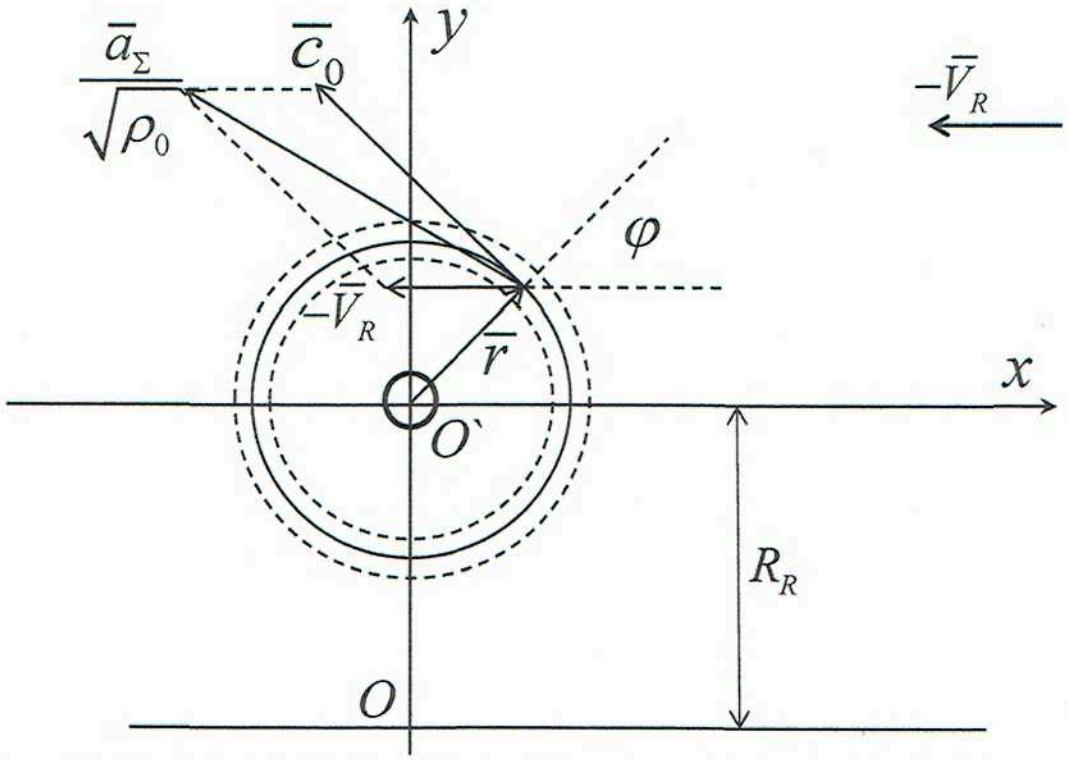

Fig. 4: The cross section of the vortex ring by the plane in which the translational velocity vector of the ring lies, in a moving coordinate system; O is the center of the ring, O' is the center of the vortex, R_R is the radius of the ring. Dotted circles represent a circular vortex element with a thickness dr inside which the investigated vector $\mathbf{a}_0$ current line is located

Just as in an Eulerian fluid, the formula (25) is valid for the value G. The relation for the magnitude of the "centripetal" force dF_{CP} acting on the element dl of the vortex ring has the same form (26) as in the Eulerian fluid.

Consider the cross section of a vortex ring. To simplify the analysis, let the current lines in the vortex be concentric circles. Consider the circular element $r, r+dr$ of the vortex cross-section. The contribution dG to the magnitude of the force G given by this element is equal to:

$$dG = (p_0 - p) \cdot 2\pi r \cdot dr = 2\pi \cdot q \cdot c \cdot r \cdot dr,$$

since

$$p_0 - p = \varepsilon = cq$$

The contribution $\delta(dF_{CP})$ of the circular element to the "centripetal" force dF_{CP} created by the element dl is equal to:

$$\delta(dF_{CP}) = dG \cdot d\alpha = \frac{2\pi qcr \cdot dr \cdot dl}{R_R} \qquad (42)$$

Let's analyze the centrifugal force $d\mathbf{F}_{CF}$ acting on the element dl. We will make preliminary remarks. This problem is similar to the well-known hydrodynamic problem of the motion of a cylinder with circulation in an ideal medium of the Eulerian model [10, p. 175], however, there are significant differences. Firstly, the medium under consideration has the property of superfluidity; in this case, the medium flows through each other. As a result of such mutual flow, the interaction energy arises [2, p. 117]. Secondly, simplifying assumptions were made, as a result of which it was possible to solve the problem without introducing the method of complex variables.

Consider a current line in a circular element $r, r+dr$. Let's determine the total vector $\mathbf{a}_\Sigma$ formed when the ether runs into a vortex moving relative to the ether. The modulus of the vector $\mathbf{a}_0$ on the considered current line before summation with the incoming flow is equal to:

$$a_0 = C / 2\pi r. \qquad (43)$$

The total vector $\mathbf{a}_\Sigma$ can be defined as follows. Let's define the velocity vector $\mathbf{c}_0$ in the vortex. The modulus of this vector $\mathbf{a}_0$ according to (8) is equal to:

$$c_0 = a_0 / \sqrt{\rho_0},$$

and the vector $\mathbf{a}_0$ direction coincides with the direction of the vector $\mathbf{a}_0$. Then we geometrically sum the vector $\mathbf{c}_0$ with the velocity vector of the incoming flow $-\mathbf{V}_R$. We get a vector $\mathbf{a}_\Sigma / \sqrt{\rho_0}$ whose square is:

$$\frac{a_\Sigma^2}{\rho_0} = c_0^2 + V_R^2 + 2c_0 V_R \cos(\mathbf{c}_0, -\mathbf{V}_R),$$

where $(\mathbf{c}_0, -\mathbf{V}_R)$ is the angle between the vectors $\mathbf{c}_0$ and $-\mathbf{V}_R$.

The square of the module of the total vector $\mathbf{a}_\Sigma$ is equal to:

$$a_\Sigma^2 = \rho_0 (c_0^2 + V_R^2 + 2c_0 V_R \cdot \sin\varphi) = \rho_\Sigma \cdot c^2, \tag{44}$$

where

$$\rho_\Sigma = \rho_0 \left(1 + \frac{V_R^2}{c^2} + \frac{2V_R \sin\varphi}{c} \right);$$

where φ is the angle between the axis x and the radius vector $\mathbf{r}$ drawn from the center of the vortex $O`$ to the point M at which the vectors $\mathbf{c}_0$ and $-\mathbf{V}_R$ are summed:

$$\varphi = \frac{\pi}{2} - (\mathbf{c}_0, -\mathbf{V}_R);$$

When the incoming flow passes through the vortex, the angle $(\mathbf{c}_0, -\mathbf{V}_R)$ is smaller $\pi/2$ on the upper half of the vortex, so the pressure on the upper half of the vortex decreases. On the lower half of the vortex, on the contrary, the angle $(\mathbf{c}_0, -\mathbf{V}_R)$ is greater $\pi/2$, so the pressure increases here. At the same time, due to the symmetry of the pressure distribution pattern relative to the axis y, the sum of the projections of forces acting along the axis x is zero. There is a centrifugal force $d\mathbf{F}_{CF}$ (analogous to the Zhukovsky force in an Eulerian fluid) directed from the origin $O`$ in the direction of increasing values y. The force $d\mathbf{F}_{CF}$ acting on the element dl of the ring is calculated using equation (2), where the square of the modulus of the vector $\mathbf{a}_\Sigma$ is determined by the ratio (44). Projecting the resulting ratio onto the axis y, we get:

$$-\frac{\partial p}{\partial y} = \frac{\partial}{\partial y}\left[\rho_0 (c^2 + V_R^2 + 2cV_R \sin\varphi) \right] = 2\rho_0 \cdot cV_R \frac{\partial}{\partial y}\left(\frac{y}{r} \right).$$

The derivative on the right side is equal to:

$$\frac{\partial}{\partial y}\left(\frac{y}{r} \right) = \frac{(\partial y/\partial y)\cdot r - y \cdot \partial r/\partial y}{r^2} = \left| \frac{\partial r}{\partial y} = \frac{2y}{2\sqrt{x^2+y^2}} = \frac{y}{r} \right| =$$

$$= \frac{r - y^2/r}{r^2} = \frac{r^2 - y^2}{r^3} = \frac{x^2}{r^3} = \frac{\cos^2\varphi}{r}$$

Substituting this derivative into the previous expression, we get:

$$-\frac{\partial p}{\partial y} = 2\rho_0 \cdot cV_R \frac{\partial}{\partial y}\left(\frac{y}{r}\right) = \frac{2\rho_0 \cdot cV_R \cos^2\varphi}{r} \tag{45}$$

To calculate the contribution created by a circular element of thickness $r, r+dr$ and length dl, multiply (45) by the volume element $d\tau = r \cdot dr \cdot dl \cdot d\varphi$ and integrate along the angle φ from the angle $\varphi = 0$ to 2π. We get:

$$dF_{CF} = 2\rho_0 \cdot cV_R dr \cdot dl \int_0^{2\pi} \cos^2\varphi \cdot d\varphi = 2\pi\rho_0 \cdot cV_R dr \cdot dl. \tag{46}$$

Ratios (42) and (46) are formulas for centripetal and centrifugal forces acting on an elementary layer $r, r+dr$, length dl. In stationary motion, the centripetal and centrifugal forces acting on the layer are equal. Therefore, we equate ratios (42) and (46):

$$\frac{2\pi qcr \cdot dr \cdot dl}{R_R} = 2\pi\rho \cdot cV_R dr \cdot dl. \tag{47}$$

Now we need to integrate (47) along the radius r from radius r_0 to infinity, where r_0 is the radius of the cavitation cavity in the center of the vortex. Before integrating (47) by radius r, we multiply both parts of the equality by the radius. Since the density ρ depends on the radius, we write the density without the index "zero". Having reduced by an amount c, we write the integration in the following form:

$$\frac{dl}{R_R}\int_{r0}^{\infty} qr \cdot 2\pi r \cdot dr = V_R dl \int_{r0}^{\infty} \rho \cdot 2\pi r \cdot dr \tag{48}$$

Strictly, the upper limit of integration should be not ∞, but the radius R_R of the ring, however, for an infinitely thin ring, these integration limits are equivalent. When integrating (48), the integral in the left part is equal to the moment of momentum dK of the medium rotating around the element dl of the vortex filament:

$$\frac{dK}{dl} = \int_0^{\infty} qr \cdot 2\pi r \cdot dr,$$

and the integral in the right part is equal to the mass per unit length of the vortex filament:

$$\frac{dm}{dl} = \int_0^{\infty} \rho \cdot 2\pi r \cdot dr.$$

Integrating over the entire circumference of the ring, we get:

$$\frac{K}{R_R} = V_R \cdot m,$$

or

$$R_R = \frac{K}{m \cdot V_R},$$

This is the formula (38). In this formula K is the sum of the moments of momentum of elementary disks impaled on a circular axis:

$$K = R_R \int_0^{2\pi} d\alpha \int_0^{\infty} qr \cdot 2\pi r \cdot dr, \qquad (49)$$

m is the mass-energy of the medium involved in the vortex motion:

$$m = \frac{1}{c^2} \int_{\tau} \varepsilon \cdot d\tau$$

Thus, the formula (38) is proved. The very fact of the complete coincidence of the structures of formula (38) and de Broglie formula (37) indicates a lot: this coincidence can hardly be accidental. However, in order for the stated interpretation of the de Broglie formula to become a theory, all the quantities considered in this proof must be calculated. In [2], the calculation and evaluation of these values were performed.

It is necessary to comment on the above sequence of determining the total vector $\mathbf{a}_\Sigma$. When obtaining the ratio (44), the procedure of geometric summation of vector $\mathbf{c}_0$ and the vector $-\mathbf{V}_R$ of the incoming flow velocity was used, as a result of which the vector $\mathbf{c}_\Sigma = \mathbf{a}_\Sigma / \sqrt{\rho_0}$ modulus may be greater than the speed of light (in the sense of the concept of "speed of light" given in section 2. However, this does not mean that superluminal "speeds" are possible. To sum up the movements, it is necessary to geometrically sum up not the velocity vectors, but the vectors $\mathbf{a}_i$ of the flows superimposed on each other. In [2], a vector $\mathbf{a}_i$ addition scheme is shown, as a result of which the result does not differ from (44).

The formula (38) is proved only at low, non-relativistic energies of the translational motion of the ring. Therefore, it is necessary to further expand, interpolate this ratio to a range of higher energies, like the de Broglie ratio, which is extended to the entire range of electron energies.

Another direction of further work is the analysis of the properties of a vortex ring for non–stationary ring modes, which is an extension of the de Broglie equation from a stationary mode to a non-stationary one. In quantum mechanics, the Schrodinger equation is used for this.

7 Further development of the kinetic theory of matter

On the basis of the presented model of the ether and the genesis of the quantities mass, time, charge, a further, increasingly complex structure of the Universe can be understood and constructed. Firstly, those concepts of Newtonian physics for which there cannot be any visual models in Newtonian physics can be rationally understood. First of all, this applies to the concept of potential energy, as well as the related concept of interaction force.

According to the kinetic theory of matter, elementary particles are vortices in the world medium – ether. The vector **a** field of each vortex extends theoretically to infinity. The fields of particles overlap each other, while the vector **a** summation of vectors occurs and the interaction energy E_{IA} is formed

$$E_{IA} = \int_{\tau} a_1 a_2 \cdot \cos\alpha \cdot d\tau \qquad (50)$$

Where $\mathbf{a}_1$, $\mathbf{a}_2$ are the motion vectors of vortices 1 and 2, τ is the volume of interaction. The force $\mathbf{F}_{12}$ of interaction between vortices arises, as a result of which atoms are formed; atoms combine into molecules and macroscopic bodies are formed. Each macro body consists of many interconnected vortices, so there is a field around the bodies formed as a result of the superposition of fields of many particles. This total field is the gravitational field of bodies.

In the monograph [2] the genesis of other concepts of Newton's physics are shown. Thus, Newton's physics describes a higher form of motion of matter relative to the ether.

8 Consequences of the formula (41)

To explain experimental facts that have no visual models in quantum mechanics, twentieth-century physics offers interpretations that cannot be called explanations; they should be called "justifications based on postulates." In quantum mechanics, particles have a set of esoteric properties; these properties are simply attributed to particles based on the thesis "this is the nature of things." This impossibility of a simple explanation of the phenomena of transformation of matter into a field and back is inherent in all theories that contrast matter and vacuum. The construction of a simple mechanism of such transformation is possible only on the basis of the theory of continuous media, that is, the kinetic theory of matter. According to the proposed concept, the essence of phenomena is very simple, but experimental manifestations of this essence can be quite complex.

The analytical proof of the formula obtained by de Broglie heuristic method changes the approach to these experimentally obtained properties; all properties

receive a visual mechanical explanation. Let's consider brief summaries of these explanations.

8.1 Uncertainty of the electron position

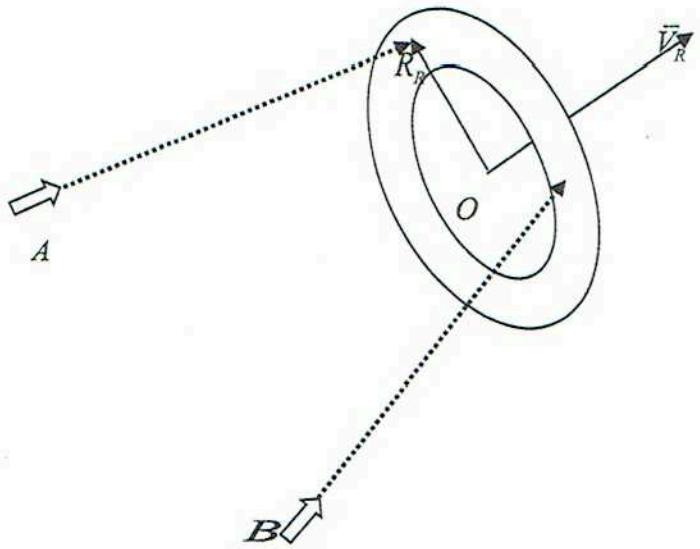

Fig. 5: Explanation of the physical meaning of Heisenberg's "uncertainty principle". The collision of probing projectiles A and B with an electron - vortex ring does not occur at the same point, but at any of the points of the circumference of the ring, at a distance R_R from the center of the ring, that is, from the point O at which (according to the concepts of the substantial theory) the electron is located.

Consider the uncertainty of the electron's position, which has entered science under the name of the "Heisenberg uncertainty principle". The electron is not a point object, but a vortex ring (Fig. 5). The collision of the ring with other micro–objects does not occur at the same point, but at any of the points of the circumference of the ring, since only in the center of the vortex there is a cavitation cavity impervious to probing projectiles. Therefore, when an electron collides with different objects, different electron coordinates are obtained. For a quantitative explanation, we write (41) in the following form:

$$R_R \cdot mV_R = \hbar .$$

This equality sets the lower bound of the uncertainty of the electron's position. In real measurements, the error of the "measuring device" is also introduced, which makes equality an inequality:

$$R_R \cdot mV_R \geq \hbar, \tag{51}$$

which explains the meaning of the experiments interpreted as the uncertainty of the electron position. With an increase in the momentum mV_R of the ring, the uncertainty in the measurement of the coordinate decreases, as the radius R_R of the ring decreases; this corresponds to the experiment.

8.2 Electron dimensions

Modern physics believes that an electron is an object no larger than $\sim 10^{-16} cm$. But ideas about such dimensions are incompatible with experiments on measuring the spin of an electron. A simple calculation shows that a rotating ball of such a radius can have a moment of momentum $\hbar/2$ only if the speed of rotation on the surface of the ball is many times higher than the speed of light. The real way out of this impasse is to accept the idea that the size of the electron is several orders of magnitude larger than $\sim 10^{-16} cm$. The presented concept naturally overcomes this contradiction. The vortex field in an ideal medium theoretically extends to infinity, so the momentum of the vortex in the ether is quite large.

Since an electron is not a ball, but a vortex ring, it is not enough to set one size for it; at least two values are needed:

1) The radius R_R of the ring. Formula (40) establishes a correspondence between the circumference $2\pi R_R$ of the ring and the de Broglie wavelength λ. Thus, according to the presented concept, the circumference of the ring is a quantity called by quantum mechanics "de Broglie wavelength".

2) The radius of the vortex core r_0. It is this value that is determined in experiments on measuring the size of an electron by the collision method. Collisions occur at any of the points of the circumference of the ring, so the measurement is not of the radius of the ring R_R, but of a much smaller magnitude r_0, that is, the magnitude $\sim 10^{-16} cm$.

8.3 Wave properties of an electron

The wave properties of an electron are explained based on the model of an electron as a vortex ring in the ether. A vortex ring is an elastic system in which vibrations can occur that can propagate along the perimeter of the ring. Since an integer number of standing waves should fit on the circumference of the ring, it

automatically follows that the circumference of the ring should be a multiple of the wavelength of the electron. The ratio (40) determines the wavelength of the first harmonic of de Broglie waves. For the wavelengths λ_i of the subsequent harmonics, we have:

$$2\pi R_R \equiv n\lambda_i. \tag{51}$$

The reason for the experimentally observed wave properties of the electron are the wave processes occurring inside the structure of the electron as a vortex ring.

8.4 Electron spin

One of the experimental facts contributing to the rejection of physics in the 20s of the XX century from visual models was the detection of electron spin. The experiment proves that there is some kind of rotation inside the structure of the electron, since there is a moment of momentum. However, attempts to understand this rotation visually, like the rotation of a spinning ball, have failed completely. Spin has properties that cannot be explained in principle within the framework of the concept of the opposition of matter and vacuum; explanations are possible only on the basis of continuum mechanics. Let's consider two properties of spin that have no explanation in quantum mechanics, but receive simple explanations in the theory being presented:

1) An abnormally large value of the electron's own angular momentum (spin), equal to $\hbar/2$;

2) The projection of spin on the direction of the magnetic field takes only two values: $+\hbar/2$ and $-\hbar/2$.

If we consider (as quantum mechanics considers) an electron to be an object whose size does not exceed $\sim 10^{-16} cm$, then a visual explanation of property 1) is impossible. As noted above, in the section "Electron dimensions", in order for a ball of this size to have a moment of momentum $\hbar/2$, it must rotate so fast that the speed on the surface of the ball must exceed the speed of light by almost five hundred thousand times. Such an assumption destroys the SRT. The only real way out is to assume that the size of the electron is several orders of magnitude larger. Such a hypothesis contradicts quantum mechanics, but is in agreement with the theory stated, according to which an electron is a vortex in an ideal medium. The vortex field extends theoretically to infinity, decreasing according to a certain law. According to (39), the momentum K of the vortex is equal to the reduced Planck constant $\hbar$. In [2], the angular momentum of the vortex in the ether was calculated using the Mathcad program. A formula for calculating the angular momentum of a vortex in the ether is obtained

$$K \equiv \hbar = \int_{\tau} \left| (\boldsymbol{\eta} - \boldsymbol{\eta}') \times \mathbf{q} \right| \cdot d\tau \qquad (52)$$

where $\mathbf{q}$ is the momentum density of the medium at a given point; $\boldsymbol{\eta}$ is variable vector radius of the considered point of the medium performing rotational motion; $\boldsymbol{\eta}'$ is the vector radius of the points of the circle of the ring around which rotation occurs; τ is the volume in which the movement occurs.

When entering the data included in (52), the Mathcad program calculates the value of the integral. In addition to creating a technique for calculating the spin of an electron, this example shows that ***the integral of the angular momentum of a vortex in the ether converges***. This result is of particular importance due to the fact that, as is known, the integrals of the angular momentum in the ideal fluid of the Eulerian model diverge [5, p. 200]. The analysis of the reasons for the convergence of integral (52), carried out in [2], shows that the momentum density in an ethereal vortex decreases faster with an increase in the radius of rotation than the momentum density in a vortex in an Eulerian fluid. The convergence of the vortex angular momentum integral in the ether proves that the ether, that is, the world medium of the presented model, is the only ideal medium in which the vortex angular momentum integral converges.

Let's consider how the theory explains property 2. The experimental detection of this property of the electron spin has put physics into a stupor. This property means that the electron spin vector does not precess when an electron enters a magnetic field (Stern and Gerlach, 1922). If we consider an electron to be a rotating object of the ball type, then such a property is impossible: any rotating object under the action of a force tending to change the position of the axis of rotation precesses. This was one of the reasons that physics, after futile attempts to explain this fact, announced that spin is a "purely quantum property" that cannot have a visual explanation. However, from the standpoint of the structure of the electron as a vortex ring, this property has a rational explanation. There are rotating elements inside the electron structure, but due to the closure of the vortex line, the sum of projections of elementary moments of momentum on any axis is zero. Therefore, the electron – vortex ring is oriented in a magnetic field without precession, and then one of the halves of the vortex line is "captured" by a magnetic field. From this interpretation of spin, an unambiguous conclusion follows that ***the spin of a free electron is zero; the moment of momentum occurs only when the ring hits the magnetic field***. This process is described in [2].

9 Mechanical models of electromagnetism

Usually, courses in electromagnetism and quantum mechanics first expound electromagnetism, and then quantum mechanics as "a doctrine more complex than electromagnetism". From the standpoint of the stated concept, on the contrary, the theory of the structure of an electron as a single object should be stated earlier, since it is simpler than the theory of electromagnetism as a theory of group behavior of electrons.

9.1 Electrostatics

In the Maxwell-Lorentz theory (hereinafter referred to as M-L theory) of electromagnetism, there are absurdities and absurdities, that is, difficulties of a fundamental nature. One of such difficulties is the "point charge paradox", according to which the intrinsic electric energy of an elementary charge is infinite. There is no such absurdity in the theory being presented.

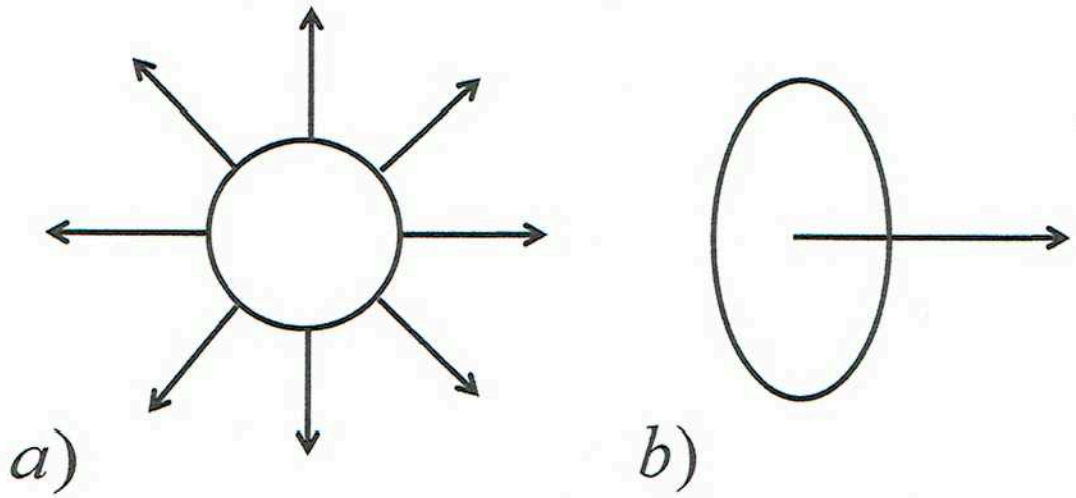

Fig. 6: Geometric structure of the elementary charge: a) in the Maxwell-Lorentz theory; b) in the theory being presented.

In the M-L theory, an elementary electric charge is geometrically similar to a macroscopic charged ball (Fig. 6). In the theory presented, an elementary charge – electron is a vortex ring in the ether that is, geometrically it represents one line of force orthogonal to the plane of the ring. Let's consider how a charged ball is formed on the basis of such a spherically asymmetric structure.

Suppose there is a conducting body, for example, a copper ball, in which an excess of such vortex rings is created (Fig. 7). Due to their ability to self-move, the rings tend to the surface of the ball, stop on the surface and create a vector field in

the surrounding space. The field of each ring is described by the expression (34). The total field is equal to the vector sum of the fields of all rings. There is a theorem of hydrodynamics, also applicable in electrodynamics, according to which the vector sum of fields created by dipoles distributed over a sphere is zero [5, p.291], [11, p.73], that is

$$\oint_{\sigma}\left[-\frac{C}{4\pi}\nabla\int_{\Sigma}\frac{\partial}{\partial n}\left(\frac{1}{r}\right)d\Sigma\right]d\sigma=0, \tag{53}$$

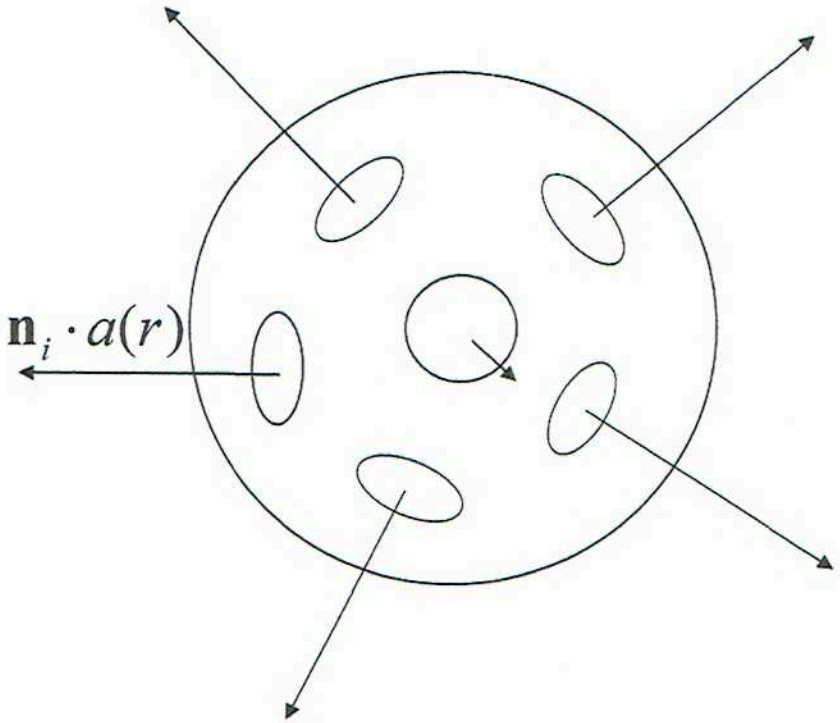

Fig. 7: Formation of a spherically symmetric charged ball based on spherically asymmetric elementary charges

where Σ is a surface resting on the contour of the ring; σ is a closed surface over which the vortex rings are distributed. Consequently, the first terms in the right part of relation (34) mutually compensate each other. Thus, the field around the ball is equal to the geometric sum of the vectors $\mathbf{a}_{//EM}$ created by each ring. This is the electrostatic field.

It is shown in [2] that bodies "charged" with such vortex rings interact with each other in full accordance with the experiment. Bodies charged with rings of the same type repel each other, charged with rings of opposite types attract. The empirically obtained Coulomb's law is analytically proved.

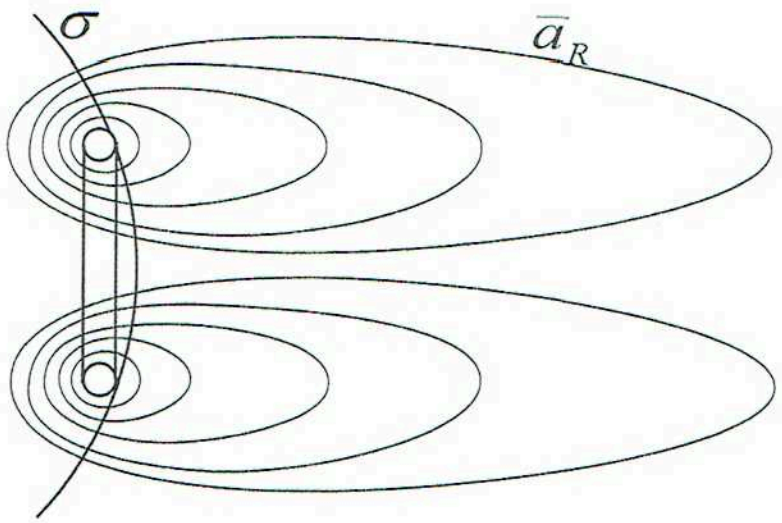

Fig. 8: Image of the ring field stopped on the surface of a charged body. If a connection is imposed on the translational motion of the ring, then forces arise that stretch the field of the ring in the direction of the stopped movement

Let us briefly consider the physical picture of the process of charging the ball (in the M-L substantial theory, this process is called the process of electric displacement). Fig. 8 shows one vortex ring stopped on the surface of the ball. The ring cannot go beyond the ball due to the presence of a cavitation cavity in the center O` of the vortex, but for the vector **a** field, due to the superfluidity of the medium, obstacles cannot exist. Since the translational velocity V_R becomes zero, the centrifugal force $d\mathbf{F}_{CF}$ disappears and the compression of the ring begins. But the movement of vortex lines in the direction of the center O of the ring generates force $d\mathbf{F}_{CF}$ (analogous to the Zhukovsky force) acting in the direction of the stopped

translational motion of the ring. This force stretches the ring field in this direction. The energy of the translational motion of the ring is transformed into the energy of elastic deformation of the field.

Each ring, according to (35), gives a contribution to the total field of the vector $\mathbf{a}_{//EM}$ in the surrounding space. Spreading the integral (35) over the entire surface σ of the sphere, we obtain the Gauss theorem:

$$Ne = \oint_{\sigma} \mathbf{a}_{//EM} \cdot \mathbf{n} \cdot d\sigma \tag{54}$$

Therefore, in the mode of electrostatics, the vector $\mathbf{a}_{//EM}$ corresponds to the vector of the electric field strength $\mathbf{E}$ of the M-L theory

$$\mathbf{a}_{//EM} \sim \mathbf{E} \tag{55}$$

Obviously, the Gauss theorem (54) is valid only in such an integral form, the transition to an infinitesimal volume is impossible. Therefore, the "point charge paradox" does not exist in this theory.

The "electric force" generated by the vortex ring when stopped can be easily calculated. To do this, consider the force $\mathbf{G}$. As follows from the definition (25), the value G is the rest energy density of the electron – vortex ring per unit length of the vortex line:

$$G = \int_{\sigma} (p_0 - p) \cdot d\sigma = \int_{\sigma} \varepsilon \cdot d\sigma = E_{kin} / 2\pi R_R \tag{56}$$

A centripetal force acts on each element dl of the ring, which can be calculated by the formula (26). When the ring is compressed, the force acting on each element of the ring is transformed into force acting in the direction of the stopped movement. Therefore, the total "electric force" F_{EL} with which the vortex ring presses on the barrier:

$$F_{EL} = G \cdot 2\pi = (E_{kin} / 2\pi R_R) \cdot 2\pi = m_0 c^2 / R_R \tag{57}$$

Where E_{kin} is the kinetic energy of the ether in the vortex ring, that is, it is the rest energy of the electron

$$E_{kin} = m_e c^2 = 0{,}511 \cdot 10^6 eV$$

The magnitude of the electric force depends on the radius R_R of the ring, that is, on the energy of the translational motion of the ring. We calculate this force for a ring with the maximum energy of translational motion, that is, a ring whose velocity tends to magnitude c. Substituting the value c in (41) instead of the velocity V_R, we obtain the reduced Compton wavelength $\bar{\lambda}_C$

$$R_{R\min} = \hbar / m_e \cdot c = \bar{\lambda}_C = \lambda_C / 2\pi \tag{58}$$

Substituting this value in (57), we get the value of the "electric force":

$$F_{EL}(R_R = \overline{\lambda}_C) = 1,6 \cdot 10^{-19} \cdot 0,511 \cdot 10^6 J / 3,86 \cdot 10^{-13} m = 0,21N \qquad (59)$$

Since this force is applied to the particle by mass $m_e = 0,91 \cdot 10^{-30} kg$, it is, without exaggeration, a gigantic force. The reason for such a large amount of electrical interaction is that, according to (57), the rest energy of the particle takes part in the genesis of the electric force. For low-energy electrons, this force is much less. Let's calculate, for example, the electric force for an electron with the energy $50eV$ of translational motion. To do this, we calculate the radius of the vortex ring at such energy. The radius of the ring is calculated by the formula for the de Broglie wave:

$$R_R = \frac{\hbar}{m_e V_R} = \left| V_R = \sqrt{2E_{//} / m_e} \right| = \frac{\hbar}{\sqrt{2m_e E_{//}}} \qquad (60)$$

Substituting the value of the mass-energy of the electron, that is, the kinetic energy E_{kin} of the ether in the vortex ring, we get:

$$F_{EL} = G \cdot 2\pi = (E_{kin} / 2\pi R_R) \cdot 2\pi = m_e c^2 / R_R = m_e c^2 \sqrt{2m_e E_{//}} / \hbar$$

$$F_{EL} = \frac{9,1 \cdot 10^{-31} \cdot 9 \cdot 10^{16} \sqrt{2 \cdot 9,1 \cdot 10^{-31} \cdot 50 \cdot 1,6 \cdot 10^{-19}}}{1,05 \cdot 10^{-34}} = 2,976 \cdot 10^{-3} (N)$$

9.2 Permanent magnetic field

From the standpoint of the theory presented, there are no separate "entities" – an electric field and a magnetic field: these fields are different manifestations of the same vector $\mathbf{a}_{//EM}$. In the electrostatics mode, the vector $\mathbf{a}_{//EM}$ creates such a state of the medium in the space around the charged ball, which at the macroscopic level is perceived as an electrostatic field. In DC mode, the vector $\mathbf{a}_{//EM}$ takes a different form.

Consider the picture of the creation of a magnetic field. Suppose there is a closed conducting circuit in which, with the help of a current source, the axes of the vortex rings are oriented along the contour in any one, certain direction of circumvention of the contour. Fig. 9 shows a rectilinear segment of this closed contour. We consider all rings to be the same, and we also consider the distances between the rings to be equal. The cores of the rings are fixed in place by means of external barriers, and the fields of the rings move freely in the surrounding space.

Thus, in this concept of a magnetic field, vortex rings – electrons do not move along a conductor. As shown in section 5, under these conditions, each ring creates a satellite flow, that is, a vector $\mathbf{a}_{//EM}$ flow. Satellite streams circulate through a closed

current loop at a speed of c. The field of each ring is described by the relation (34) for the vector $\mathbf{a}_{R2i}$. The total vector field at any point P outside the wire is equal to the sum of the vectors $\mathbf{a}_{R2i}$ created by all the rings:

$$\mathbf{a}(P) = \sum_{i}^{N} \mathbf{a}_{Ai} + \sum_{i}^{N} \mathbf{a}_{//EMi} \cdot \tag{61}$$

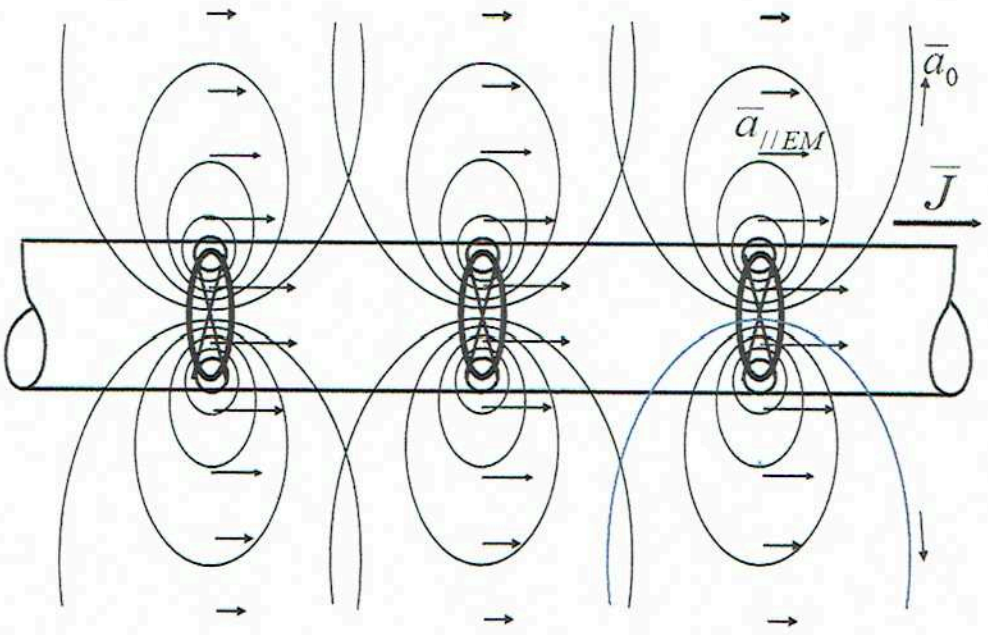

Fig. 9: Image of a rectilinear segment of a contour with a current. The rings inside the conductor represent vortex rings-electrons; oval lines represent the lines of the potential vector $\mathbf{a}_A$; arrows parallel to the conductor represent the vector $\mathbf{a}_{//EM}$. The barriers superimposed on the translational velocities of the rings are represented by crossed rectilinear segments

However, a theorem can be proved that the first term in (61) is zero, that is, the sum of the potential components of the fields of all dipoles is zero. Let's prove this theorem. Consider the first sum on the right side. The vector $\mathbf{a}_A$ has potential Φ. The potential created by the i-dipole (for simplification, we consider the rings to be single dipoles) at the point P

$$\Phi_i = -\frac{C}{4\pi}\nabla\left(\frac{1}{r_i}\right)\cdot\mathbf{n}_i\,, \tag{62}$$

where $\mathbf{r}_i$ is the radius vector drawn from the point P to the point where the vortex ring is located. The total potential Φ_{SUM} created by all rings at a point P:

$$\Phi_{SUM} = -\frac{C}{4\pi}\sum_i^N \nabla\left(\frac{1}{r_i}\right)\cdot\mathbf{n}_i\,. \tag{63}$$

With a large number of rings, the direction of the normal $\mathbf{n}_i$ to the plane of the ring tends to the direction of the element of the contour length $\Delta\mathbf{l}_i \equiv \Delta\mathbf{r}_i$, and the sum tends to the integral, which takes the form of circulation:

$$\Phi_{SUM} = -\frac{C}{4\pi}\oint_L \nabla\left(\frac{1}{r}\right)\cdot d\mathbf{l} = 0\,, \tag{64}$$

where L is a closed current loop. This integral is zero as the circulation of the potential vector $\nabla\left(\frac{1}{r}\right)$. Therefore, the vector $\mathbf{a}$ field at a point P is equal to the sum of the vectors $\mathbf{a}_{//EM}$ created by all the vortex rings flowing through the conductor:

$$\mathbf{a}_\Sigma(P) = \sum_i^N \mathbf{a}_{//EMi}\,. \tag{65}$$

The total field of vectors $\mathbf{a}_{//EM}$ distributed in space around a wire with a current is a magnetic field. Therefore, in the described concept of electromagnetism, the electric current is not localized within the conductor. Current is the movement of satellite energy flows, theoretically extended to infinity. Each electron – vortex ring creates a single satellite flow. The vector $\mathbf{a}_{//EMi}$ taken with a minus sign is a vector of the "current density $\mathbf{j}_i$" created by one electron:

$$\mathbf{j}_i = -\mathbf{a}_{//EMi} \tag{66}$$

The minus sign on the right side (66) is introduced because, according to the notation accepted in physics, the positive direction of the current is the direction of movement of positive charges. Since the direction of the vector $\mathbf{a}_{//EM}$ coincides with the direction of motion of the electron, that is, the "negative charge", then, consequently, the directions of the vectors $\mathbf{a}_{//EM}$ and $\mathbf{j}$ are opposite.

The law of vector $\mathbf{a}_{//EM}$ distribution in the space around the conductor is similar to the law of vector potential $\mathbf{A}$ distribution in M-L theory

$$\mathbf{a}_{//EM} \sim \mathbf{A} \tag{67}$$

Each elementary current J_i represents the power of the vector $\mathbf{a}_{//EM}$ flow through an infinite plane Σ normal to the conductor:

$$J_i = -\int_{\Sigma} \mathbf{a}_{//EMi} \cdot \mathbf{n} \cdot d\sigma \tag{68}$$

Comparison of expressions (68) and (35) shows that in this model of electromagnetism, the quantities "current J" and "charge e" have the same dimension. The elementary current J_i created by a single electron – a vortex ring, is a quantity called "electron charge e" by physics. The total current J_{SUM} through the plane Σ is equal to the sum of all elementary currents:

$$J_{SUM} = -\sum_{i}^{N} \int_{\Sigma} \mathbf{a}_{//EMi} \cdot \mathbf{n} \cdot d\sigma = -\int_{\Sigma} \mathbf{a}_{//EM} \cdot \mathbf{n} \cdot d\sigma \tag{69}$$

Thus, the force vector in this concept is a vector $\mathbf{a}_{//EM}$. Instead of the magnetic field strength $\mathbf{H}$ lines of the M-L theory, which are orthogonal to the conductor, in the theory being presented, the magnetic interaction is determined by vector $\mathbf{a}_{//EM}$ lines that are parallel to the conductor. Such a magnetic field model brings the theoretical description of the magnetic interaction into line with experimental facts. One of the facts of the discrepancy between the M-L theory and the experiment is the description of the interaction of magnetic fields of parallel conductors.

Fig. 10 shows two parallel conductors with currents and images of the magnetic fields of these currents based on the M-L theory and the theory being presented. In the M-L theory, magnetic fields are described using a vector $\mathbf{H}$, in the theory being presented using a vector $\mathbf{a}_{//EM}$. It is shown in [2] that if one strictly follows the M-L theory, then there is no correspondence between the theory and the experiment:

1) According to the M-L theory, the conductors will not attract, but repel;

2) The force of interaction between the conductors is proportional not $1/d$ (as the experiment gives), but $1/d^2$, where d is the distance between the conductors.

The inability of a theoretical explanation of the magnetic interaction from the standpoint of M-L theory is indicated by Whittaker [12, p. 375]. Therefore, in the modern formal mathematical theory, the "explanation" of the interaction of conductors is not based on the M-L theory, but on the basis of the empirical Ampere formula:

$$dF_{12} = \frac{\mu_0}{4\pi} \frac{J_1 J_2}{d} dl, \text{ (Ampere)} \tag{70}$$

where J_1, J_2 are currents in the conductors according to M-L theory.

From the standpoint of the theory being presented, the geometry of the fields becomes clear. With parallel conductors, the vectors $\mathbf{a}_{//EM}$ created by these conductors are also parallel. An area of reduced pressure is created in the area between the conductors, so the conductors are attracted.

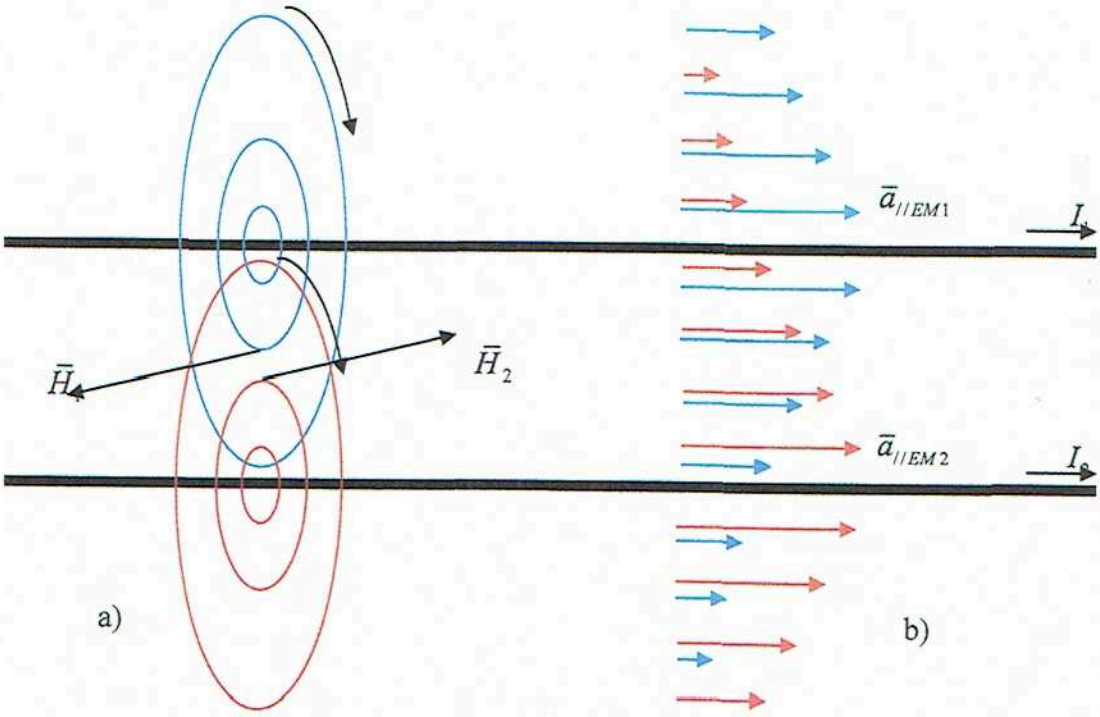

Fig. 10: Image of the magnetic field of parallel conductors: a) based on the M-L theory, using vectors $\mathbf{H}$; b) based on the theory presented, using vectors $\mathbf{a}_{//EM}$. Vectors related to conductor 1 are shown in blue; those related to conductor 2 are shown in red

There are no such inconsistencies in the theory presented, and the empirical Ampere formula (70) has been proved analytically [2, p. 284]. Thus, despite the strangeness of the presented models and their difference from the usual images of fields in the M-L theory, the presented models have such theoretical and experimental confirmations that the M-L theory cannot compete with. There are nonsenses and absurdities in the M-L theory, that is, fundamental difficulties that cannot be solved within the M-L concept. Let's list the main of these difficulties.

1) There are no mechanical models of phenomena;

2) The existence of the point charge paradox;

3) The force of interaction between conductors with current (Ampere force) is calculated not according to the M-L theory, but according to the empirical Ampere formula.

9.3 The nature of radiation

If we remain within the framework of reality, that is, we assume that all phenomena can be understood visually, and then two concepts of the physical nature of radiation are possible: 1) light and other EM radiation are particles flying in the void; 2) light are waves propagating in some medium. The theory being presented considers light to be waves in world medium, however, unlike Maxwell's abstract model, it operates with real mechanical quantities. In addition, the proposed theory explains the phenomenon of radiation quantization, that is, the experimental fact that radiation occurs in portions, quanta.

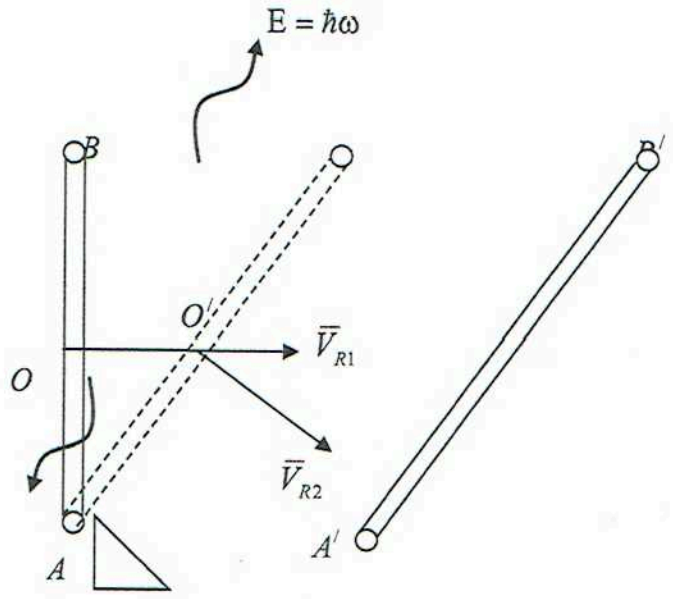

Fig. 11: Simplified image of the vortex ring during radiation.

Let us briefly consider the physical principles on which the explanation of the radiation process is based; for a more complete explanation, see [2]. Formula (29)

proves that in an ideal medium there is a circulation of surface forces along the contour of the vortex ring. Due to the curvature of the vortex line, a force directed to the center of the curvature of the vortex line acts on each element dl of the ring. The same principle underlies the proposed model of propagation of light and other electromagnetic oscillations. Just as the curvature of the ring element dl creates the ability of the ring to self-move, the curvature of the emerging element of the vortex line creates a force with which this element acts "on itself".

Let's construct a general picture of the radiation mechanism. Radiation occurs when the ring loses kinetic energy. The radiation energy E_{RAD} is the part of the kinetic energy that is released when the velocity of the ring decreases from the initial velocity $\mathbf{V}_{R1}$ to the final velocity $\mathbf{V}_{R2}$:

$$E_{RAD} = E_{KIN1} - E_{KIN2} \tag{71}$$

That is, the first condition of radiation is the braking of the ring. The second necessary condition is the rotation of the ring plane during braking, so the whole process can be defined as "asymmetric braking".

Let the vortex ring move at a speed $V_{R1} << c$ (Fig. 11). At the moment of time t_1, the circumference of the ring meets an obstacle at a point A and the process of asymmetric braking begins. When hitting an obstacle, the speed of the ring element at the point A decreases to a certain velocity $V_{R2} < V_{R1}$. However, the velocity V_{R2} is not transmitted instantly to the entire ring: the point B diametrically opposite to the point A continues to move in a straight line. Since the point B is ahead of the point A in translational motion, it can be simplistically assumed that the plane of the ring rotates around the axis passing through the point A. The decrease in speed moves along the circumference of the ring in the form of deformation. At this time, there is a process of radiation into the region of space enclosed between the former and the new positions of the plane of the ring. Figure 11 shows the initial and final phases of the process. During the asymmetric braking, the ring plane rotates around the axis passing through the point A by an angle θ_{rad}. At the moment of time t_2, the deformation reaches a point B. The rotation of the ring plane ends, and along with the rotation, the radiation process ends and the ring continues to move freely, but at a lower speed V_{R2} and in a different direction.

As you know, there is no visual model of radiation in modern physics; the process is described only formally. The presented model, despite its simplified, sketchy nature, provides a visual explanation of the radiation frequencies, as well as the quantum nature of the radiation. The portionality of the radiation is an organic consequence of the deformation movement along the perimeter of the ring. When the deformation reaches the point B, the radiation stops. On this basis, the Planck

formula for radiation can be analytically obtained. Let's write the formula (41) in the following form:

$$mV_R = \frac{\hbar}{R_R}$$

Multiply both parts of this equality by the speed differential dV_R and integrate from the initial speed V_{R1} to the final speed V_{R2}. We will get:

$$m\int_{V_{R1}}^{V_{R2}} V_R \cdot dV_R = \hbar \int_{V_{R1}}^{V_{R2}} \frac{dV_R}{R_R}.$$

The integrand on the right side is the doubled differential of the angular velocity of rotation of the plane of the ring around the point A:

$$\frac{dV_R}{R_R} = 2 \cdot d\omega$$

Therefore, it is possible to replace the variable in the right part:

$$m\int_{V_{R1}}^{V_{R2}} V_R \cdot dV_R = 2\hbar \int_{\omega_1}^{\omega_2} d\omega$$

As a result of integration, we have

$$E_{RAD} = \frac{mV_{R1}^2}{2} - \frac{mV_{R2}^2}{2} = \hbar \cdot 2(\omega_1 - \omega_2) \qquad (72)$$

The ratio (72) can be written in the following form:

$$E_{RAD} = \hbar \cdot 2(\omega_1 - \omega_2) = \hbar \cdot \omega_{RAD} \qquad (73)$$

This is a complete analogue of Planck's formula on the discrete nature of radiation:

$$E_{RAD} = \hbar \cdot \omega_{RAD} \quad \text{(Planck, 1900)} \qquad (74)$$

Relationship (74) clearly shows the mechanical meaning of the quantities characterizing radiation. The plane of the vortex ring rotates with a variable angular velocity ω. The angular frequency ω_{RAD} of the emitted quantum makes sense of the doubled difference of the angular velocities of rotation at the beginning and at the end of the act of radiation

$$\omega_{RAD} = 2(\omega_1 - \omega_2) \qquad (75)$$

10 Conclusion

The history of physics is the history of the expulsion of substantial quantities from science and the explanation of the nature of these quantities by mechanical motion. "*From the totality of these new trends, the ultimate goal of the development*

of physics is becoming clearer – the creation of a unified science of physics as the mechanics of all matter, as the kinetics of all material movements ". [13, p. 189]. The most striking example on this path is the explanation of the physical nature of heat by mechanical motion and the expulsion from science of "caloric substance" as an alleged source of thermal phenomena. The substantial theories that existed in physics described processes mathematically well enough, but did not construct visual models. Instead of models, it was assumed that there was some "fantastic substance" that had the necessary properties and did not possess any other properties. Substantial theories are the initial methods of describing phenomena and, despite their natural philosophical fallacy, are useful and necessary for science. However, we must always remember that the substantial theory is a temporary, initial stage of the physical theory, which will be replaced by the stage of constructing a model of the phenomenon. The construction of a model of phenomena opens up new horizons for the development of science. For example, the knowledge of the essence of heat made it possible to construct an absolute temperature scale and on this basis build a new, wide field of low temperature physics.

Explanation of the nature of electric charge by mechanical motion was the goal and task of physics of the XIX century, including the great physicists W. Kelvin, J. Maxwell, G. Helmholtz. However, in the XIX century this problem was not solved. Kelvin, describing Maxwell's theory of electromagnetism, said that this theory is a step back from completely defined mechanical concepts.

At the end of the XIX - beginning of the XX century, such properties of matter were experimentally discovered, which, according to the creators of the new physics, could not be understood within the framework of mechanics. At the same time, most of the scientists of the older generation in the natural philosophical sense remained in the same positions, although they could no longer offer a constructive physical theory. The science of the XX century, considering the failure of the physics of the XIX century in the construction of mechanical models of electromagnetism, decided that the construction of such models is impossible. The desire for mechanical models is declared "naive mechanicism". Therefore, physical problems are solved formally and mathematically.

According to the author, it is the desire to know the Universe without models that is naive; this leads to the unrestrained growth of esoteric "entities" in science. The modern science of Nature is no longer physics; this teaching can be called "selected chapters of mathematics for the abstract description of experimental facts." Therefore, there are, for example, such esoteric "explanations" of phenomena, according to which "an electron has its own moment of momentum, but this moment of momentum is not due to rotation."

Only the construction of models gives a real understanding of phenomena and expels esotericism from science. The presented concept shows that the construction of a mechanical model of an electric charge is possible. The solution to this problem lies beyond the search of the creators of physics of the XX century. To solve the problem, a large-scale revision of physical representations is necessary, starting with Newton's physics. Substantial quantities are not only "charge", but also the quantities "mass" and "time". At the same time, the proposed concept negates the basic methodological idea of modern abstract physics, which consists in the fact that "the more complex the mathematical theory, the more accurately it reflects the structure of the Universe." It is shown that the mathematical description of the world medium of this model is even simpler than the theory of continuous media.

The desire of a rationalist scientist for a mechanical explanation of all phenomena is indestructible. There is a growing rejection of abstract mathematical physics in the scientific community and a craving for a visual, model understanding of the essence of phenomena [14]. Expressing full agreement with this aspiration, it should be noted the following. All these attempts at explanation occur within the framework of either correction or modernization of Newton's mechanics. As follows from this work, the solution to the problem lies much deeper – not at the level of tactics of cognition, but at the level of strategy, that is, at the level of philosophy. Newton's physics, strictly, is not mechanics at all, since there are substantial quantities in it. Mechanics is only a physical theory, which is based on the world medium – ether, since such a theory is described using only mechanical quantities.

The construction of mechanical models of the genesis of the quantities mass, time, charge completes the mechanical explanation of the fundamental concepts of physics. Thus, the goal set by W. Thomson (Introduction) has been achieved or, at least, the direction of movement towards this goal has been determined.

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